

Journal of Research of the

National Institute of Standards and Technology

he National Institute of Standards and Technology was established in 1988 by Congress to "assist industry in the development of technology . . . needed to improve product quality, to modernize manufacturing processes, to ensure product reliability . . . and to facilitate rapid commercialization . . . of products based on new scientific discoveries."

NIST, originally founded as the National Bureau of Standards in 1901, works to strengthen U.S. industry's competitiveness; advance science and engineering; and improve public health, safety, and the environment. One of the agency's basic functions is to develop, maintain, and retain custody of the national standards of measurement, and provide the means and methods for comparing standards used in science, engineering, manufacturing, commerce, industry, and education with the standards adopted or recognized by the Federal Government.

As an agency of the U.S. Commerce Department's Technology Administration, NIST conducts basic and applied research in the physical sciences and engineering, and develops measurement techniques, test methods, standards, and related services. The Institute does generic and precompetitive work on new and advanced technologies. NIST's research facilities are located at Gaithersburg, MD 20899, and at Boulder, CO 80303. Major technical operating units and their principal activities are listed below. For more information contact the Publications and Program Inquiries Desk, 301-975-3058.

Office of the Director

- National Quality Program
- · International and Academic Affairs

Technology Services

- · Standards Services
- Technology Partnerships
- · Measurement Services
- · Technology Innovation
- Information Services

Advanced Technology Program

- Economic Assessment
- Information Technology and Applications
- · Chemical and Biomedical Technology
- · Materials and Manufacturing Technology
- Electronics and Photonics Technology

Manufacturing Extension Partnership Program

- · Regional Programs
- National Programs
- Program Development

Electronics and Electrical Engineering Laboratory

- Microelectronics
- Law Enforcement Standards
- · Electricity
- Semiconductor Electronics
- Electromagnetic Fields¹
- Electromagnetic Technology¹
- Optoelectronics¹

Chemical Science and Technology Laboratory

- · Biotechnology
- Physical and Chemical Properties²
- Analytical Chemistry
- Process Measurements
- Surface and Microanalysis Science

Physics Laboratory

- Electron and Optical Physics
- Atomic Physics
- · Optical Technology
- Ionizing Radiation
- Time and Frequency¹
- Quantum Physics¹

Materials Science and Engineering Laboratory

- Intelligent Processing of Materials
- Ceramics
- Materials Reliability¹
- Polymers
- · Metallurgy
- · NIST Center for Neutron Research

Manufacturing Engineering Laboratory

- Precision Engineering
- Automated Production Technology
- Intelligent Systems
- Fabrication Technology
- · Manufacturing Systems Integration

Building and Fire Research Laboratory

- Structures
- · Building Materials
- · Building Environment
- · Fire Safety Engineering
- Fire Science

Information Technology Laboratory

- Mathematical and Computational Sciences²
- Advanced Network Technologies
- · Computer Security
- Information Access and User Interfaces
- High Performance Systems and Services
- Distributed Computing and Information Services
- Software Diagnostics and Conformance Testing

¹At Boulder, CO 80303.

²Some elements at Boulder, CO.

Journal of Research of the National Institute of Standards and Technology

Volume 102 Number 6 November–December 1997

Board of Editors

Barry N. Taylor

Chief Editor

Nancy M. Trahey, Technology Services

Alan F. Clark, Electronics and Electrical Engineering Laboratory

Theodore V. Vorburger, Manufacturing Engineering Laboratory

John R. Moody, Chemical Science and Technology Laboratory

Ronald Collé, Physics Laboratory

Cynthia K. Montgomery, Materials Science and Engineering Laboratory

Nicos S. Martys, Building and Fire Research Laboratory

Alan H. Goldfine, Information Technology Laboratory

Daniel W. Lozier, Information Technology Laboratory

Matt Young, Boulder Laboratories

Chris E. Kuyatt, Washington Editorial Review Board

Donald R. Harris

Managing Editor

Julian M. Ives

Technical Production Editor

Ilse E. Putman, Nancy L. Gogniat, Karen J. Wick

Electronic Composition



U.S. Department of Commerce—William M. Daley, Secretary
Technology Administration—Gary R. Bachula, Acting Under Secretary for Technology
National Institute of Standards and Technology—Raymond G. Kammer, Director

The Journal of Research of the National Institute of Standards and Technology features advances in measurement methodology and analyses consistent with the NIST responsibility as the nation's measurement science laboratory. It includes reports on instrumentation for making accurate and precise measurements in fields of physical science and engineering, as well as the mathematical models of phenomena which enable the predictive determination of information in regions where measurements may be absent. Papers on critical data, calibration techniques, quality assurance programs, and well-characterized reference materials reflect NIST programs in these areas. Special issues of the Journal are devoted to invited papers in a particular field of measurement science. Occasional survey articles and conference reports appear on topics related to the Institute's technical and scientific programs.

ISSN 1044-677X Coden: JRITEF Library of Congress Catalog Card No.: 89-656121

Contents

Articles

Radiometric Measurement Comparison Using the Ocean Color Temperature Scanner (OCTS) Visible and Near Infrared Integrating Sphere	B. Carol Johnson, F. Sakuma, J. J. Butler, S. F. Biggar, J. W. Cooper, J. Ishida, and K. Suzuki	627
Uncertainty and Dimensional Calibrations	Ted Doiron and John Stoup	647
Current Distributions in Quantum Hall Effect Devices	M. E. Cage	677
Electron-Impact Total Ionization Cross Sections of CH and C ₂ H ₂	Yong-Ki Kim, M. Asgar Ali, and M. Eugene Rudd	693
Conference Reports		
1997 Wireless Communications Conference	Roger B. Marks and Michael S. Heutmaker	697
The Automatic Radio Frequency Techniques Group Conference on Characterization of Broadband Telecommunications Components and Systems	Roger B. Marks and Gary D. Alley	703
Indexes to Volume 102		
Subject Index to Volume 102 Author Index to Volume 102		745 749
News Briefs		
GENERAL DEVELOPMENTS		709
NIST Research Shows Nanocomposite Can Take the Heat Research May Help Hunt for Interstellar Iron		
New Standard Is Boon to "Smart" Sensors Tenth Baldrige Award Given to Four U.S. Companies "Take Five" to Learn About NIST in New Video Calorimeter Makes Better Gas and Liquid Measurements		710

Volume 102, Number 6, November–December 1997 Journal of Research of the National Institute of Standards and Technology

Multiple Precision Software Improves Algorithm Testing and Evaluation Program Service NIST Publishes Minimum Interoperability Specification for Public Key Infrastructure (PKI) Components New Insight into Properties of Magnetic Nanostructures	711
Laser-like Atomic Beams: Coherence Properties of Matter Waves Precision Chemistry of Oxygen Reactions New Accuracy Achieved in Neutron Scattering-Length Measurements STRBase: A Short Tandem Repeat DNA Database	712
NIST, CU Collaboration Applies New Measurement Methods to Exhibit Sub-Nanosecond Switching Times in Magnetic Recording Head Materials Probing the Antiferromagnetic Spin Structure in "Exchange-biased" Fe ₃ O ₄ /CoO Superlattices	713
First Direct Observation of the Deformation of Metallic Nanolaminates Energy-Related Inventions Program Makes Recommendations NVLAP Recognition Agreements Mutual Recognition Agreement Between the United States and the European Union	714
NIST Releases New Version of Indoor Air Quality Model Gage Block Intercomparison Data Presented NIST Researcher Collaborates with Industry and Academia to Study Dynamic Effects in High Speed Milling	715
First Annual Users Meeting of the NIST Radiochemistry Intercomparison Program International Workshop on Ultrasonic and Dielectric Measurements Held in Gaithersburg Information Exchange Held by NIST and AIST/Japan	716
Thirteenth Symposium on Thermophysical Properties Low Gas-Flow Proficiency Testing	717
Construction of the SURF III Facility Begins NIST to Propose Inspection Standard to ISO An AC Voltage Source with Quantum Mechanical Accuracy	718
NIST, USFA Strengthen Firefighting Partnership Semiconductor Wire Bonding "Bible" Expanded Stress, Strain Effects on Energy Storage System Defined Tests Show Foam Protects Homes in Fire Storm Path	719
NIST Invention Has "Polish" February Workshop Seeks Improved Trade With China	720
Predicting the Texture of Sheet Metals by EMATs Phillips Wins 1997 Physics Nobel Prize Expect Software Development Facilitates Design of Electronic Packaging Solder Interconnect: Joining Capabilities	721
Ultrasonics and Your Future Dental Crown NIST Reference Data Web Site Attracts Wide Interest From Industry Incorporation of Thermal Radiation in Large Eddy Fire Simulations NIST Provides Key Services to AAMA Evaluation of Reverberation Chambers for Vehicle Immunity Testing	722

Volume 102, Number 6, November-December 1997 Journal of Research of the National Institute of Standards and Technology

Nonlinear Dynamics Models for High-Speed Machining Neutron Radiography Helps Characterize Fuel Cell Operation New Ultraviolet Radiometry Facility at SURF	723
New Infrared Spectromicroscope at SURF Improved Stability for the AT1 Time Scale Environmental Sensitivities of Hydrogen Masers Improved Internet Time Distribution	724
New Spectral Observations Using Laser Magnetic Resonance (LMR) New Far-Infrared Lasers Lines High Temperature Superconducting Materials Database Now Accessible on the World Wide Web Primer Published on the U.S. Certification System From a Governmental Perspective Energy-Related Inventions Program Makes Recommendations	725
Thermodynamics of the Conversion of Chorismate to Prephenate New Sensitive Surface Technique for Vibrational Spectroscopy of Biomolecular Materials	726
Telepresence Microscopy and Microanalysis: First Demonstration Provisional Patent Filed on Ion Current Sensor	727
New Partial Discharge Detection System Developed for High-Voltage Equipment Diagnostic NIST Establishes Statement of Intent with IRC NIST Establishes Statement of Understanding with IBHS NIST and the National Security Agency (NSA) Form Partnership in Security Testing	728
Two New Precision Measurement Grants Awarded NIST Hosts First International Conference on Atomic and Molecular Data and Their Application (ICAMDATA)	729
New NIST-Industry Consortium Focuses on Optical Properties of Materials Workshop on High Resolution Cold Neutron Spectroscopy Standards for Testing of Fiber-Matrix Interface in Composites	730
NIST Conference Held on "Using Voluntary Standards in the Federal Government" NIST and Industry Work Together to Define Interoperable Message Passing Interface Standard NIST and NSA Collaborate on Firewall Protection Profile	731
NIST Focuses on Java Conformity Assessment NIST Workshop on the Exchange of Dimensional Inspection Information Heavily Attended by Industry Intelligent Systems and Semiotics (ISAS'97) Conference "Refrigerants for the 21st Century" Conference Held at NIST	732
NIST Hosts Thin-Film Metrology Workshop Phillips Recognized by Congress NIST Scientists Give Keynote Lectures at Asia Pacific Metrology Symposium	733
NIST Seeks Data on Software Failures Agencies Launch Technology Roadmap Effort NIST Helps Better Characteristics LF Anechoic Chambers	734
Consortium Seeks Better Measures for Emerging Industry	735

Volume 102, Number 6, November–December 1997 Journal of Research of the National Institute of Standards and Technology

STANDARD REFERENCE MATERIALS New Standard Is Freeze-Dried What?	735
Irish/Old Bay Combo Helps Laboratories Assess Ocean Radioactivity Highly Accurate Gold/Platinum Thermocouple Thermometers Produced and Certified for Issuance as Standard Reference Material 1749 High-Purity Tin and Zinc Freezing-Point Cells Produced and Certified for Issuance as Standard Reference Materials 1747 and 1748, Respectively	736
Calendar	737